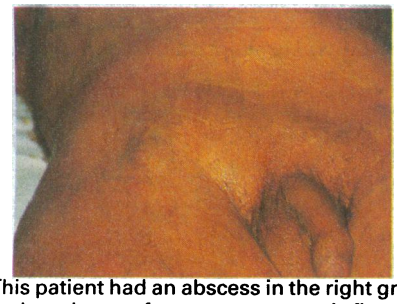

This patient had an abscess in the right groin and an abscess from an aortoenteric fistula secondary to an infected graft. He survived after removal of the infected aortic graft and bilateral axillofemoral grafting.

Patients with suspected graft infection require urgent assessment in hospital.

Aortoenteric fistula

The possibility of an aortoenteric fistula must be considered in any patient with an aortic graft who presents with a gastrointestinal haemorrhage. A warning bleed usually occurs before a catastrophic haemorrhage. Emergency admission to hospital is required and—in the absence of any obvious cause—exploratory laparotomy should be planned with the expectation of having to remove the graft and restore the blood supply with bilateral axillofemoral grafts.

Conclusion

When there is doubt about a problem a prompt telephone discussion between general practitioner and surgeon will help to resolve it.

This article has discussed the complications of peripheral arterial reconstruction, but the principles apply equally to reconstructions of other arteries such as carotid, renal, and mesenteric arteries. Arterial reconstructions are complex but they enable an independent mobile existence for many patients. The common problems are the most simple to manage. With prompt action the more serious problems can usually be resolved satisfactorily, leading to restoration of function.

The histogram is based on data derived from Brewster *et al*, *Arch Surg* 1983;**118**:1104. We thank Mr A V Pollock for the picture of colour lymphography and we acknowledge with thanks the assistance of the audiovisual department, St Mary's Hospital, London, in the preparation of the illustrations.

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The ABC of Vascular Diseases has been edited by Mr John H N Wolfe.

Health and the Environment

Waste disposal: fresh looks at a rotting problem

Alison Walker

Most people take waste disposal for granted, yet it amounts to much more than the weekly collection of dustbin bags from our doorsteps. Britain alone produces more than 2·5 billion tonnes of waste a year from a wide range of sources including mines and quarries, factories, farms, hospitals, and construction sites (table). Historically, waste has not been disposed of with sufficient care and previous legislation has not been completely effective (box).

Air and water pollution, which to a large extent arise from waste discharged into the environment, are dealt with in other articles in this series. The BMA's report *Hazardous Waste and Human Health* examines the effect of waste in greater detail.[2] This article considers certain aspects of waste of particular interest to the medical profession.

Clinical waste

Clinical waste arises from hospitals, health centres, general practitioners' and dentists' surgeries, veterinary surgeries, and from the homes of people with diseases such as diabetes or with renal failure who treat themselves. Among the potential risks from clinical waste, that from sharps (broken glass, needles, and other sharp instruments) is of considerable concern as a source of bloodborne disease agents such as hepatitis B virus and HIV. The risk of seroconversion after percutaneous exposure to blood infected with HIV is only one in 200 but as high as one in five for hepatitis B virus. Immunisation against hepatitis B is available to all health workers, but no such precaution can be taken for HIV infection.[3]

Medical staff are not the only people at risk of sharps injuries in a hospital. During a 10 month study at a university hospital in the United States more than 320 sharps injuries were reported, of which 13% occurred during or after disposal; most of these injuries were caused by sharps protruding from rubbish waiting for disposal.[4] Another study, from the Hospital for Sick Children, Great Ormond Street, London,

Sources of waste, England and Wales

Type	Quantity (million tonnes/year)
Liquid industrial effluent	2000
Agriculture*	250
Mines and quarries (including china clay)*	130
Industrial	50
Hazardous and special	3·9
Special	1·5
Domestic and trade	28
Sewage and sludge	24
Power station ash	14
Blast furnace slag	6
Building	3
Medical wastes	0·15
Total	2505·15

*Not registered under Control of Pollution Act 1974.

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found that porters and those working in the central sterile supplies unit had the highest rate of sharps injuries.[5] At least 37 documented cases of seroconversion after occupational exposure to HIV have occurred world wide, most of which were caused by some form of sharps injury.[3] The only way to prevent transmission of infection is to assume that all clinical waste is potentially infected and adopt a universal safe practice.

Disposal of clinical waste

In Greater London alone some 30 000 tonnes of bagged clinical waste are produced every year.[6] The problem of disposing of such a large volume without risk is considerable.

The practice of segregating clinical waste from domestic and general waste by putting it into yellow bags and containers has been poorly adhered to according to evidence presented to the House of Commons environment committee.[1] This system was introduced in 1982 after concern was raised over the way in which clinical waste was being mixed with general waste. In the south east, in particular, clinical waste had been found in public areas, including holiday beaches. Even by 1989 the problem had not been solved. A scandal hit the headlines when clinical waste from London ended up on a landfill site licensed for domestic waste in Cheshire.

The London Waste Regulation Authority examined the disposal of clinical waste in 1989, taking evidence from both the public and private sectors.[6] It found many of the hospital incinerators to be old and overloaded, producing belching smoke and possibly dioxins, and operating below recommended temperatures—partly to economise on fuel. The authority also found scenes of burst yellow bags with their contents of dirty syringes and dressings spilling out on to the floor being handled by inexperienced disposal staff wearing minimal protective clothing. One of the authority's strongest recommendations was to reiterate the need for all clinical waste to be incinerated and not disposed of in landfill sites. For this to happen more incinerators would need to be built and existing ones brought up to standard. The BMA's report on hazardous waste echoed this response, adding that information on existing incinerators should be pooled.[2]

BARRY LEWIS/NETWORK

Control of waste disposal

Specific waste disposal legislation in Britain is relatively recent but has taken several leaps forward since it was first introduced in the early 1970s. The first act aimed specifically at waste disposal was the 1972 Deposit of Poisonous Waste Act, passed after the discovery of drums of cyanide in a children's adventure playground in the Midlands.

The 1972 act was replaced by the more comprehensive Control of Pollution Act in 1974. This was criticised by the House of Commons Environment Committee in 1989.[1] According to the committee, the inadequacy of the regulations governing waste disposal had had serious consequences. Waste disposal authorities had acted as both poacher and gamekeeper—both operating and regulating waste disposal sites. Unscrupulous operators had been allowed "to dump waste, almost unchecked, because of variations in licensing and loopholes in the Control of Pollution Act 1974."

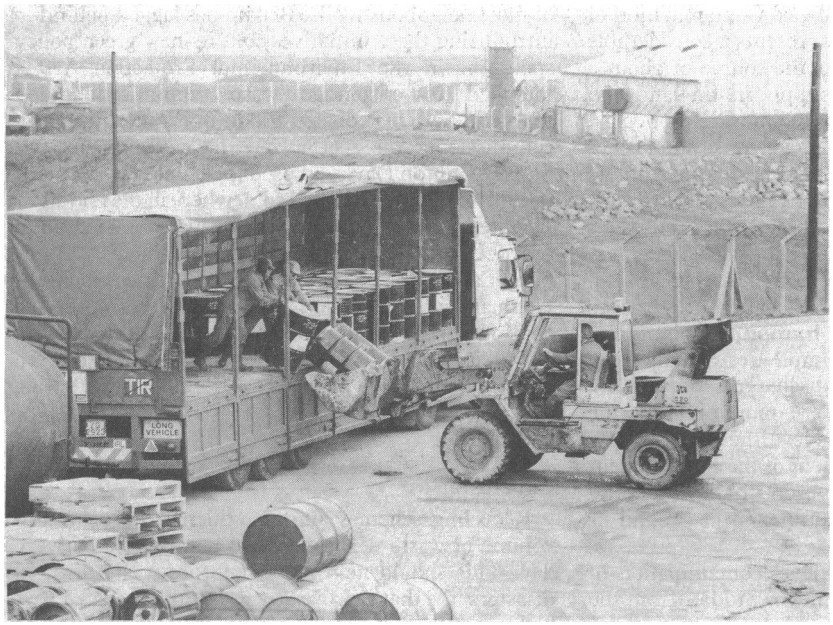
The 1990 Environmental Protection Act, the latest piece of legislation governing waste disposal in Britain, is intended to correct earlier deficiencies. One of its successes has been to separate out the roles of regulator and operator; regulation has become the sole responsibility of waste regulation authorities, policed by organisations such as Her Majesty's Inspectorate of Pollution and the National Rivers Authority, and disposal is carried out by waste disposal authorities and private contractors. An important theme of the Environmental Protection Act has been the control of waste from the "cradle to the grave."

The lifting of crown immunity from clinical waste disposal in April 1991 will allow a welcome and long overdue review of the system. Hospitals now risk prosecution if they fail to meet the required standards under the Clean Air Act 1956 and 1968 and Control of Pollution Act 1974. Managers had until October 1991 to submit their programmes for upgrading but have until 1996 to implement the changes—far too long according to David Boyd of the National Association of Waste Disposal Contractors. The association has produced guidelines on clinical waste disposal covering segregation, packaging, transport, and disposal by high temperature incineration. "It's a professional game," said David Boyd, "which should not be carried out by untrained operators running aging inhouse incinerators." The standards defined in its guidelines, says the association, should be adopted by both private and hospital disposal teams.

Countries like Germany have introduced advanced systems for treating clinical waste at the site of production.[6] The waste is first shredded until it is unrecognisable and then treated with microwaves to ensure thermic disinfection. The waste can then be converted into granules if necessary and shipped to landfill sites. The new system can be used for treating all clinical waste including syringes, needles, and dialysis equipment, and other countries like Italy are already considering introducing it.

Waste from households, shops, and offices

The social reformer Edwin Chadwick, working during the nineteenth century, was one of the first people to link disease and death with poor sanitary conditions in the streets of Britain. Such conditions are now largely a thing of the past as local authority and private dustcarts regularly collect rubbish from households, shops, and offices. Thanks to this generally efficient service, very little harm actually comes from solid municipal waste. Problems can still arise when the waste is not collected during times of industrial action. A strike by refuse collectors in Liverpool



MARTIN BOND/ENVIRONMENTAL PICTURE LIBRARY

Little is known about long term health effects of toxic waste

during last summer left rotting piles of rubbish on the streets, posing a health threat from the multiplying rat population, which acts as a reservoir for diseases such as leptospirosis.[7] Even without industrial action a health risk arises when unhygienic conditions allow cockroaches and fly populations to multiply among refuse since almost every known excreted pathogen has been isolated from these vectors.[8]

Fly tipping, or the illegal dumping of waste from both domestic and industrial sources, is a considerable problem in urban areas.[9] Far from being innocuous, fly tipped waste has been found to be "extremely hazardous," according to Mr Bill Townend of the London Waste Regulation Authority. A study carried out in London the 1980s, he said, found that 17 out of 58 sites of fly tipped material analysed were heavily contaminated with toxic substances such as heavy metals and posed a potentially serious risk to public health.

Hazardous industrial waste

Hazardous industrial waste has a high public profile and is therefore the main subject for public concern about safety of waste and its disposal. There have, however, been hardly any studies to provide scientific evidence to support this concern, and many of those existing are of poor quality.[6]

Tracing the cause of disease in an individual to previous exposure to a waste product is extremely difficult. Research based on exposure to waste products is limited, and many risk assessments are based on the known toxic effects of substances found in disposal sites, such as asbestos. This does not take into account the effects of mixing substances—the "cocktail compounds"—or the unknown nature of much waste material. Animal tests of toxicity have been used to study the effect of waste products in mammals, but they have limited application to humans. Though acute exposure to toxic substances may have clear cut effects, such as the respiratory and autonomic symptoms after poisoning with organophosphates, the effects of long term exposure are much more problematic and, with regard to public health, far more serious. Epidemiological studies may provide some of the answers but numerous confounding factors make the results difficult to interpret.

A Swedish study looked at the mortality among workers at a municipal waste incinerator.[10] Employment records dating back to 1951 were used to identify subjects for the study. More than 170 workers were identified who had been exposed to substances such as lead, mercury, cadmium, and carbon monoxide. An increased risk of lung cancer and ischaemic heart disease was found in the workers, thought to be caused by high occupational exposure to dust and gases at the incinerator. Although the study was criticised for being small, retrospective, and not fully adjusted for confounding factors, it is one of the few available on workers in the waste industry.

Extrapolating any study to the general population is fraught with problems. Toxic substances such as furans, dioxins, and polychlorinated biphenyls are ubiquitous in the environment and can make interpreting exposure difficult. Furthermore the technical means to detect trace amounts of many contaminants has outstripped the ability to predict their health risk.

Dioxin has become one of the more notorious toxic substances following the accident at a chemical plant at Seveso in Italy in 1976 when dioxins were released into the atmosphere. Dioxin is a generic term for 75 closely related compounds, the best known of which is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). Dioxins are produced as a result of the combustion of organic material such as wood or the incomplete combustion of certain hazardous materials, including polychlorinated biphenyls. Experiments in animals have shown dioxins to be teratogenic and carcinogenic, but the results in humans are not as clear. A recent large study in the United States looked at more than 5000 workers exposed to dioxins at 12 industrial plants.[11] The results overall were equivocal, but they did show a slight but significantly higher mortality from all cancers than expected—questioning the belief that low exposures are entirely safe.

Waste disposal sites

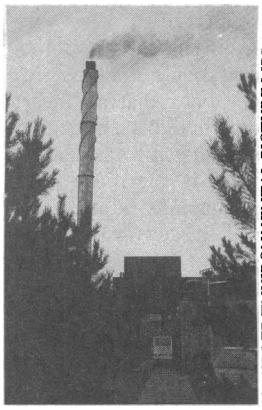
In Britain, about 90% of waste from factories, households, shops, and offices is taken to one of the 4000 or so controlled landfill sites for disposal. Most of the remainder is burned, either in a municipal incinerator or in one of the four specialised high temperature incinerators which deal with toxic waste. This contrasts with practice in many European countries—for example, Sweden—where some 60% of municipal waste is incinerated.

The transport and disposal of some toxic waste is carefully controlled under special waste regulations, which are part of the Control of Pollution Act 1974. The regulations cover the disposal of medicinal products available only on prescription, specified materials which are dangerous to human health, and substances with a flash point of 21 °C or less. Special documentation—a consignment note—is required so that the waste can be tracked from the premises of the waste producer to the point of final disposal.

Most people are suspicious of landfill sites and incineration plants which deal with waste. The NIMBY (not in my back yard) syndrome sums up most people's attitude towards them. A survey by the Department of the Environment in 1990 found the disposal of hazardous waste to be the public's biggest environmental concern—ranking higher than acid rain or pesticides.[12] "In the public mind it would appear that waste disposal sites are viewed as part of the problem of hazardous waste rather than as the solution," says the BMA in its review of hazardous waste and health.[2] But is the public right to be so concerned about waste disposal sites?

LANDFILL SITES

Landfill sites present three potential hazards—ground water pollution, land contamination, and



SONIA MILLER/ENVIRONMENTAL PICTURE LIBRARY

Many hospital incinerators are old and overloaded

generation of explosive landfill gas. Contamination of ground water, when it occurs, presents a considerable problem since ground water is the source of about a third of the drinking water supply in England and Wales. Halogenated organic compounds, in particular, are very mobile in soils and can move into ground water easily. Traces have been found in many of the aquifers in Britain, especially those in old industrial regions. Modern industrial plants also threaten ground water supplies—for example, solvents from car manufacturing plants were found to be contaminating ground water in the West Midlands.[13] Legislation does exist to protect ground water. The European Community ground water directive, for example, restricts the level of substances allowed to be discharged into ground water and these substances are monitored by the National Rivers Authority. Nevertheless, a study commissioned by the Department of the Environment in 1987 looked at 100 landfill sites in Britain and found that a third had caused contamination of ground or surface water.[14]

The health risks from low level contamination of water supplies are not fully known. Studies from the United States suggest that drinking private supplies from contaminated well water may be associated with an increase in the incidence of leukaemia, although these results have been disputed.[15] Public water supplies in Britain are better protected than private supplies from wells as they are regularly monitored and tested.

A combination of gases, particularly methane, can build up in a landfill site as landfill gas, with the potential to cause explosions with serious consequences. In 1986 gas escaped from an old landfill site leading to the explosion and destruction of a bungalow in Loscoe, Derbyshire. The Department of the Environment's review of 100 landfill sites found the problem of landfill gas to be seriously underestimated.[14] No gas control measures were found in 70% of sites and more than 50% lacked gas monitoring bore holes even though more than two thirds were within 500 metres of residential areas.

Contaminated land from previous indiscriminate dumping of toxic substances can have serious repercussions. Love Canal in Niagara City, New York, is a notorious example of this.[6] Between 1930 and 1952 about 20 000 tonnes of hazardous waste was dumped in the canal. It was subsequently filled in and built on. Twenty five years later tests were carried out in the area because of foul smelling liquids and sludge had been found to be seeping into the basements of houses built on the site. Children were at particularly high risk because the school playground was built directly over the filled canal, and studies have suggested an association between living in Love Canal and short stature in children.[16]

Alternative waste disposal options

In countries like Sweden domestic waste recycling schemes flourish and bottle and can banks are a feature of most neighbourhoods. Britain has lagged behind in introducing these initiatives, but its new green policy spelt out in the Environmental Protection Act is intended to encourage waste minimisation and recycling both in industry and in the home. European commissioner for energy and the environment, Mr Stanley Clinton Davis, advised the House of Commons in 1989 that Britain ranked somewhere in the middle of the international hierarchy for adequate waste disposal practices.[1] It was joined by Belgium, France, Luxemburg, and Ireland. The best countries included Denmark and the Netherlands. Furthermore, the continued practice of codisposal (the joint disposal of industrial and household waste) in Britain has led others in Europe to believe that the British are sitting on a time bomb.

Conclusion

Recycling schemes aim at reducing the enormous volume of waste which needs to be disposed of every day. This should help prevent future waste disposal disasters like that at Love Canal, but the legacy of past bad practice and the continued mismanagement of landfill sites still present health hazards. Much more information is needed before health risks can be identified with certainty. As one official from the Department of the Environment said, "If you ask 12 doctors for advice on waste you are bound to get 13 different answers." Much more research needs to be done if the health risks of waste disposal are to be identified, and in time.

I am grateful to Tara Lamont of the BMA and William Townend of the London Waste Regulation Authority for their help in compiling this article.

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